Proliferation Prevention and Detection

The proliferation of nuclear, chemical, and biological weapons (collectively referred to as weapons of mass destruction, or WMD) is a growing threat to U.S. and world security. Our program in nonproliferation, arms control, and international security is tackling the problem of WMD proliferation across the entire spectrum of the threat. We are involved in activities to prevent proliferation at the source, to detect and reverse proliferant activities, and to counter WMD terrorism.

Before and after views of the nuclear fuel storage racks (left and right), showing the additional barriers to delay unauthorized access, on board a nuclear refueling ship for the Russian Icebreaker Fleet.

Securing Russian Nuclear Materials

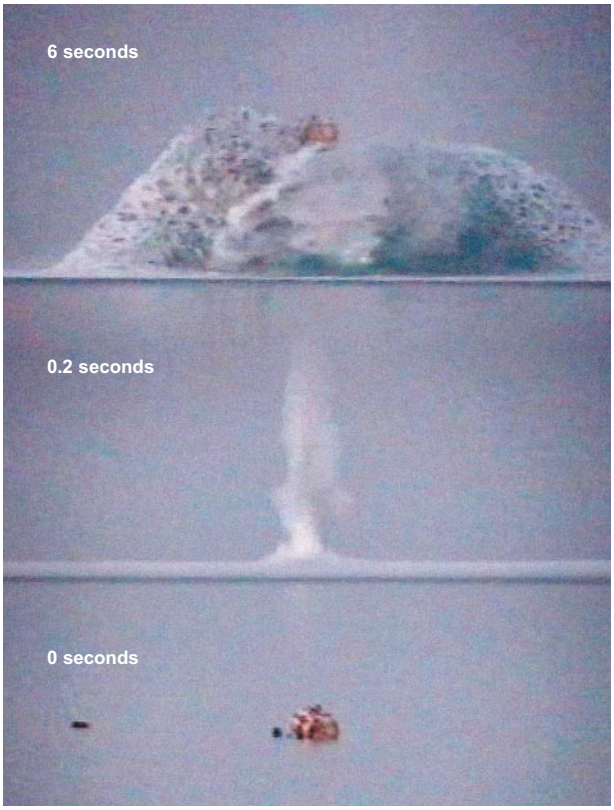
Through the DOE Materials Protection, Control, and Accounting (MPC&A) Program, we are working with Russia to secure weapons-usable nuclear materials at the sites that store, process, or use those materials. For example, Livermore leads the MPC&A team that is working with the Russian Navy and Icebreaker Fleet to improve the security of fresh fuel for these nuclear-powered vessels. Upgrades for two refueling ships were commissioned in September 1999. The upgrades included covers for the nuclear fuel storage racks that can be removed only with special tools and sensors and closed-circuit TV to monitor the storage area and nearby corridors. The excellent working relationship among the Russian Navy, the subcontractor and system integrator (the Kurchatov Institute), and the highly trained team of DOE and national laboratory personnel is facilitating efficient problem solving and system implementation.

We lead the joint U.S.–Russian plutonium disposition activities to stabilize, immobilize, and geologically dispose of excess plutonium from Russian weapons. Industrial-scale immobilization of weapons-plutonium-containing materials is planned at one or more of the three plutonium processing sites in Russia by 2004. Livermore activities focus on supporting the industrial sites' plutonium immobilization requirements. We are developing and characterizing various immobilization waste forms for plutonium and examining the nonproliferation benefits of each.

Monitoring Improved for Nuclear Explosions

Livermore is part of a multilaboratory effort to provide the U.S. government with the R&D it needs to meet its worldwide nuclear explosion monitoring goals. Efforts are focused on seismic R&D for the

Our Center for Global Security Research sponsored a series of workshops on missile proliferation to bring together technologists and policymakers to discuss key issues. At the meeting in August 1999, the Honorable Donald H. Rumsfeld (far right), former Secretary of Defense and chair of the Rumsfeld Commission on Missile Proliferation, served as one of the panel chairs.



An underwater 5,000-kilogram explosive was detonated in the Dead Sea in November 1999. Measurements taken at various locations in the Middle East are being used to calibrate seismic stations and improve DOE's knowledge base for the area.

Middle East, North Africa, and Russia. We are working with Los Alamos and Sandia to construct a "knowledge base" that provides region-specific corrections to calculational algorithms used to locate and identify seismic events. This past year, we demonstrated that the knowledge-base concept will be able to meet U.S. monitoring goals. The locations of aftershocks from a large earthquake in the Caucasus Mountains were estimated and compared to data from published reports. Our region-specific corrections eliminated approximately 40 kilometers of bias from the estimates. Uncertainty of the aftershock locations was reduced to under 1,000 square kilometers (the limit for on-site inspections under the Comprehensive Test Ban Treaty).

We are also investigating nontraditional means of developing ground truth. From openly available satellite data, we are using pan-chromatic and synthetic aperture radar images to improve the level of ground truth in regions where physical access is difficult. For example, we are using radar data to directly identify mine collapses, which potentially are a major source of false alarms because data are similar to those of underground nuclear explosions.

New Sensors for Remote Monitoring

Chemicals associated with weapons of mass destruction (during R&D, production, testing, storage, or use) are released into the environment at levels that may be detectable by various technical means. We are developing a number of optical remote-sensing techniques for detecting, identifying, and quantifying signatures of the proliferation or use of weapons of mass destruction. Among these techniques are a hyperspectral infrared spectrometry system, a mid-wave infrared differential absorption lidar, and an echelle grating spectrometer (EGS).

We are exploring the use of the EGS for ballistic-missile defense applications. By looking at optical signatures following intercept of a hostile missile, we can use EGS to characterize in real time the impact debris and rapidly provide information about enemy warheads containing chemical or biological agents. In a June 1999 field test of the concept, EGS performed flawlessly and returned useful booster plume and intercept signature information. As a result of this success, we are now funded by the Department of Defense to use EGS in the Intercept Flight Test Program to characterize intercept events.